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## Collaborative Strategic Reading on Multi-Touch and Multi-User Digital Tabletop Displays

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**Abstract.** This paper is part of a work-in-progress that reports on the design, development, and evaluation of a Digital Collaborative Strategic Reading (DCSR) application with regard to its effectiveness in improving English as a second language (ESL) reading comprehension. The DCSR application allows users to read collaboratively on multi-touch and multi-user digital tabletop displays that support both face-to-face and computer-based interaction. The application is designed to provide systematic instruction on tabletop computers using four main comprehension strategies that form the Collaborative Strategic Reading (CSR) instructional approach. The paper addresses one main research question: ‘How does the use of the tabletop-based reading application (DCSR) affect learners’ reading processes and outcomes?’, and the following sub-questions: (1) What is the impact of the tabletop-based reading system on learners’ reading scores with regard to the reading assessments? (2) How do learners collaboratively construct meaning on the tabletop? To answer these research questions, the subjects used the DCSR application on tabletop computers in groups of four, once a week for 5 weeks. Data were collected and analysed using both qualitative and quantitative methods. Each reading session was preceded by a cloze test and followed by two types of assessment: a written recall test and a cloze test; both tests were designed to reflect the students’ comprehension of the reading passages. The paper will report on the design of the software and the administration of the study, but will focus on the analysis of the data from the different sources, and present insights into the nature of collaborative reading using the DCSR application on a tabletop computer.

**Keywords:** digital collaborative strategic reading, tabletop computing.

### 1. Introduction

The tabletop computer is an emerging technology which, with its large multi-touch surface that enables collocated synchronous collaboration, has clear potential for

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application in learning contexts. This paper will investigate the effectiveness of a tabletop-based computer application (Digital Collaborative Strategic Reading – Digital CSR or DCSR) as a collaborative reading instructional tool for enhancing the reading comprehension of English as a second language students.

International ESL students at tertiary level institutions in the UK and elsewhere need to reach a level of proficiency in English which will allow them to cope linguistically with their studies. Proficiency in reading is especially important for such students, as is effective instruction of L2 reading (e.g., [Anderson, 1999](#); [Huckin & Bloch, 1993](#)). They and other researchers argue that reading is probably the most important skill for L2 students in academic or learning contexts ([Carrell, 1988](#); [Fasheh, 1995](#); [Hafiz & Tudor, 1989](#); [Pretorius, 2000](#), p. 35; [Saville-Troike, 1984](#)).

One particular approach to teaching reading – Collaborative Strategic Reading – is based on the principles of reciprocal teaching ([Palincsar & Brown, 1984](#)), which include a number of clearly specified procedures such as collaborative group work and interactive dialogue ([Kim et al., 2006](#)). CSR has potential benefits for the teaching and learning of reading as it is designed to offer instruction of explicit specific strategies and ‘clearly specified procedures’ for reading comprehension, which are practised through collaboration at all stages of the reading activity. Instruction of this kind has been associated with positive results in enhancing reading comprehension and avoiding text comprehension failure ([Bremer, Vaughn, Clapper, & Kim, 2002](#); [Klingner & Vaughn, 1998, 1999, 2000](#); [Klingner, Vaughn, & Schumm, 1998](#); [Vaughn, Klingner, & Bryant, 2001](#)).

Collaboration among learners usually takes place around a table, and the “traditional table” is a tool that is well known for its axiomatic and intuitive support for small group collaboration; a familiar picture in educational settings. These features, as well as the rich experience that learners carry as a result of daily contact with tables in classrooms have motivated technologists to introduce interfaces for digital tabletops that share a lot of the interaction and communication features that are associated with work around “traditional tables” ([Kharrufa, 2010](#); [Kharrufa & Olivier, 2010](#); [Scott, Grant, & Mandryk, 2003](#)). As a result, the current study is concerned with the development and evaluation of an integrated application for teaching and practising reading on a tabletop computer that combines the strengths of “traditional table” collaboration with the collaborative features offered by digital tabletop computers.

## 2. Method

This project started by looking at specific requirements for designing applications for collaborative learning around digital tabletops. Studies of interaction design recommend starting with observation of how people apply their knowledge of the physical world and their everyday experience when using collaborative learning tools (e.g., [Preece, Rogers, & Sharp, 2002](#)). In addition to design guidelines drawn from previous studies,

most current tabletop-based systems are therefore based on “observational studies on the use of traditional tables” (Kharrufa, 2010, p. 7). Kharrufa and Olivier (2010), for example, developed design requirements based on a review of the relevant literature, and on their own observation of table-based collaboration, including the learners’ use of gazing, body positions, and different tools while taking part in collaborative activities. Their observations confirmed the results of other similar studies regarding issues of territoriality on the tabletop surface, orientation of artefacts such as notes on the tabletop, use of gestures, and other aspects of collaboration.

The development of the DCSR application followed an iterative design approach that involved several stages, beginning with paper prototypes, followed by digital prototypes. The digital prototypes then underwent usability testing, with each digital prototype developed, evaluated in use, modified and re-evaluated. The design of the DCSR was based on the principles of the CSR approach, observation studies of paper CSR available in the literature and the most up-to-date studies on tabletop-assisted learning.

## 2.1. DCSR implementation

The paper addresses one main research question: ‘How does the use of the tabletop-based reading application (DCSR) affect learners’ reading processes and outcomes?’, and the following sub-questions: (1) what is the impact of the tabletop-based reading system on learners’ reading scores with regard to the reading assessments? and (2) how do learners collaboratively construct meaning on the tabletop computer? To answer these research questions, the subjects used the DCSR application on the tabletop computers in groups of four, once a week for 5 weeks. Five different reading texts of similar length and difficulty (intermediate level) were used; one reading text for every reading session. Each reading session started with previewing the whole text, followed by brainstorming then prediction of the content of the text. Then the learners read the text paragraph by paragraph to get the gist, dealing with unknown words, and then write down their understanding of each paragraph in digital notes. They conclude the task with a wrap-up stage in which they evaluate and monitor their understanding of the whole text by generating questions and answers. At the end of each of these stages they collaboratively organise their notes into groups based on similarities among the ideas. In order to assess reading comprehension, students take the same cloze test before and after the reading session and a written recall test after the session. Qualitative and quantitative methods are employed for both the data collection and the data analysis procedures.

## 2.2. Preliminary results and analysis

This work-in-progress is mainly qualitative, and the qualitative results form the core of the study. However, quantitative results can reflect a lot on students’ achievement on the tabletop computer and about the impact of this technology on their performance.

Based on a preliminary analysis of qualitative data, the grouping feature, a tool for allowing the learners to organise ideas, questions or problems about the text into groups, was helpful in making students' thinking visible to their peers, thus leading to incidents of comprehension check, and encouraging requests for further explanation and elaboration as well as corrective feedback. Grouping also encouraged problem-solving and planning (e.g., by organising notes into groups), both of which require reasoning and decision making. The orientation of digital notes (i.e., who was able to read an individual learner's notes as a result of the way he or she chose to orientate them on the tabletop) and the multi-keyboard-based input facility (i.e., each learner had a keyboard they could use) acted as non-verbal prompts for feedback from other peers or for further explanation. Test results have shown an improvement in students' scores in the cloze test between the pre-test and the post-test. There is also a positive correlation between their scores in the cloze post-test and the written recall test as both variables move in tandem.

### **3. Discussion**

Preliminary findings suggest that tabletop computers and the DCSR application have potential benefits in language learning and more specifically in collaborative reading. Findings suggest that the grouping tool used each of the main reading strategies to have been tried once (brainstorming, prediction, get the gist, and wrap-up) and that it supports the externalisation of the students' thinking. During the grouping activity, students engage in organising note-slips into groups. They have already summarised ideas and written them inside digital notes to share with others during grouping. Organising the notes that contain similar ideas into groups requires planning, making decisions, and reasoning about which notes belong to which group and engages students in problem-solving throughout the whole process. The grouping tool and digital notes can also encourage scaffolding, allowing high-achievers to see others' notes on the tabletop surface and pinpoint areas of confusion that low-achievers may have, and to offer appropriate help (Pressley, Hogan, Wharton-McDonald, Mistretta, & Ettenberger, 1996).

The orientation of objects on the tabletop was found to be a useful tool for comprehension as it allows for easier reading of the text, for communication with peers, and for coordination (see Kharrufa, 2010; Kharrufa & Olivier, 2010). Other elements of effective collaboration such as space, students' behaviour and actions also affected the design of the application and students' construction of meaning while reading on tabletop computers, though consideration of these is beyond the scope of this paper.

### **4. Conclusions**

The current exploratory study of the use of a Digital Collaborative Strategic Reading application contributes to understanding how tabletop computers can support co-located

synchronous face-to-face collaborative reading and to investigating the impact of the tabletop-based computer application, DCSR, on ESL students' reading comprehension. There is evidence from a preliminary analysis of the data that learners coped well with the technology. Also, features of the DCSR software such as orientation and grouping of notes are associated both with interaction and collaboration, and with an improvement in reading comprehension and reading scores.

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